

11/14/00
JC685 U.S. PTO

UTILITY PATENT APPLICATION
UNDER 37 CFR 1.53(b)

Assistant Commissioner for Patents
Washington D.C. 20231

Case Docket No. 4504-017

Sir:

Transmitted herewith for filing is the patent application of:

INVENTOR: Chin-Sung LIU, Li-Chung PENG, and An-Ying HUANG
FOR: ELECTROMAGNETIC ACTUATOR HAVING SPECIAL COIL ARRANGEMENT
FOR IMPROVING UTILIZATION RATE OF MAGNETIC CIRCUIT THEREOF

JC685 U.S. PTO
09/711524
11/14/00

Enclosed are:

- ☒ [X] 15 pages of specification, claims, abstract
- ☒ [X] Declaration & Power of Attorney
- ☐ [] Priority Claimed
- ☐ [] Certified copies of
- ☒ [X] An assignment of the invention to ACUTE APPLIED TECHNOLOGIES, INC. and th
assignment recordation fee
- ☒ [X] Return Receipt Postcard
- ☐ [] Information Disclosure Statement, Form PTO-1449
- ☐ [] Copies of IDS Citations
- ☐ [] Change of Address
- ☒ [X] Verified Statement Claiming Small Entity Status (37) CFR 1.9(f) and 1.27(c)

The filing fee has been calculated as shown below:

	NO. FILED		NO. EXTRA	RATE	AMOUNT
Total Claims	26	MINUS 20	6	x \$9 =	\$ 54.00
Independent Claims	3	MINUS 3	0	x \$40 =	\$ 0.00
If multiple dependent claims are presented, add \$270.00					\$0.00
Basic Fee					\$ 355.00
Total of above calculations					\$ 409.00
<input checked="" type="checkbox"/> [X] Assignment and Recording Fee					\$40.00
TOTAL FEE					\$449.00

- ☒ Please charge the amount of \$449.00 to American Express 3728 327418 95003
- ☐ Please charge my Deposit Account No. 07-1337 in the amount of \$0.00. A duplicate copy of this sheet is enclosed.
- ☒ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 07-1337. A duplicate copy is enclosed.
- ☒ Any additional filing fees required under 37 CFR 1.16.
- ☒ The Commissioner is hereby authorized to charge payment of following fees during the pendency of this application or credit any overpayment to Deposit Account No. 07-1337. A duplicate copy of this sheet is enclosed.
- ☒ Any patent application processing fees under 37 CFR 1.17.
- ☒ Any filing fees under 37 CFR 1.16 for presentation of extra claims.

Respectfully submitted,

LOWE HAUPTMAN GOPSTEIN GILMAN & BERNER, LLP

Kenneth M. Berner

Kenneth M. Berner
Registration No. 37,093

1700 Diagonal Road, Suite 310
Alexandria, Virginia 22314
(703) 684-1111
(703) 518-5499 Facsimile
Date: November 14, 2000
BJH/rl

Applicant or Patentee: _____ Attorney's Docket No.: _____
Serial or Patent No.: _____
Filed or Issued: _____
For: _____

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37) CFR 1.9(f) and 1.27(c) - SMALL BUSINESS CONCERN

I hereby declare that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF ORGANIZATION: ACUTE APPLIED TECHNOLOGIES, INC.

ADDRESS OF ORGANIZATION: NO. 25, R&D ROAD II, SCIENCE-BASED INDUSTRIAL PARK, HSINCHU, TAIWAN, R.O.C.

I hereby declare that the above identified small business concern qualified as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled _____ by inventor(s) _____ described in

- ☐ the specification filed herewith.
☐ application Serial No. , filed .
☐ patent no. , issued .

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e). *NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME _____
ADDRESS _____
☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

NAME _____
ADDRESS _____
☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: YU-SHENG TSAI
TITLE IN ORGANIZATION: PRESIDENT
ADDRESS OF PERSON SIGNING: NO. 25, R&D ROAD II, SCIENCE-BASED INDUSTRIAL PARK, HSINCHU, TAIWAN, R.O.C
SIGNATURE: Yusheng Tsai
DATE: Oct. 23, 2000

ELECTROMAGNETIC ACTUATOR HAVING SPECIFIC COIL ARRANGEMENT FOR IMPROVING UTILIZATION RATE OF MAGNETIC CIRCUIT THEREOF

5 FIELD OF THE INVENTION

The present invention relates to an electromagnetic actuator for moving an object, e.g. an objective lens of an optical head, on a micro level, and more particularly to an electromagnetic actuator having specific coil arrangement for improving the utilization rate of magnetic
10 circuit so as to quickly perform the micro-level movement of the object.

BACKGROUND OF THE INVENTION

In general, the writing and reading operations of an information writing/reading apparatus are performed by a disk-shaped recording
15 medium such as a compact disk or a magneto-optical disk. For reading information from a disk, an optical head including an objective lens is used to guide the laser beam reflected off of the disk to a photosensor.

Unfortunately, a general disk is hard to be perfectly flat and symmetric, i.e. it may have inevitable warpage and eccentricity to some
20 extent. Therefore, the information writing/reading apparatus preferably includes means for moving the objective lens in response to the deviations resulting from the variable warpage and/or eccentricity of the disk. The movement is generally performed on a micro level along two orthogonal directions, i.e. a focusing direction perpendicular to the disk
25 face and a tracking direction parallel to the disk face, to compensate the focusing deviation and the tracking deviation, respectively.

In order to move the objective lens on a micro level, objective lens

actuators are developed. For the actuators using electromagnetic forces as driving power, a tracking coil, a focusing coil and a permanent magnet are involved and specifically arranged.

Please refer to Figs. 1, 2 and 3 which schematically show three kinds of conventional arrangement of the tracking coil 11, the focusing coil 12 and the permanent magnet 13. According to the proportion of the magnetic force lines passing through the coils, the utilization rate of the magnetic circuit of Fig. 1 or 2 is estimated to be 30% to 40%, and that of Fig. 3 is about 50%.

With the enhancement of writing and reading speeds, the tracking and focusing operations are required to be highly responsive. If the utilization rate of the magnetic circuit is relatively low, the driving power is not enough for the application of high-speed writing and reading operations.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide an electromagnetic actuator with improved responsive speed by increasing the utilization rate of the magnetic circuit, which has a particular coil arrangement.

According to a first aspect of the present invention, an electromagnetic actuator for moving an object along a first direction includes a first actuating coil set connected to the object for generating a first actuating force to move the object in the first direction in response to a first current density therein and a first magnetic force; and a magnetic force line generator surrounded by the first actuating coil set, and including two homopolar parts disposed with a clearance small

enough for generating magnetic force lines including a first substantially linear portion due to a repelling force between the two homopolar parts, wherein the first substantially linear portion of magnetic force lines provides the first magnetic force for the first actuating coil set.

5 Preferably, the magnetic force line generator includes two permanent magnets having respective homopoles facing each other as the two homopolar parts.

10 In an embodiment, the first direction is a focusing direction, and the first actuating coil set includes a coil holding the magnetic force line generator therein.

15 Preferably, the electromagnetic actuator further moves the object along a tracking direction perpendicular to the focusing direction. Therefore, the electromagnetic actuator preferably further includes a second actuating coil set connected to the object for generating a second actuating force to move the object in the tracking direction in response to a second current density therein and a second magnetic force. The magnetic force lines further includes a second substantially linear portion due to the repelling force between the two homopolar parts, wherein the second substantially linear portion of magnetic force lines provides the second magnetic force for the second actuating coil set.

20 Preferably, the second actuating coil set consists of two coils disposed at two opposite sides of the magnetic force line generator, respectively, each of which has a coil wall thereof substantially perpendicular to the second substantially linear portion.

25 In another embodiment, the first direction is a tracking direction, and the first actuating coil set includes two coils sandwiching the magnetic force line generator therebetween.

Preferably, the electromagnetic actuator further moves the object along a focusing direction perpendicular to the tracking direction. Therefore, the electromagnetic actuator preferably further includes a second actuating coil set connected to the object for generating a second
5 actuating force to move the object in the focusing direction in response to a second current density therein and a second magnetic force. The magnetic force lines further includes a second substantially linear portion due to the repelling force between the two homopolar parts, wherein the second substantially linear portion of magnetic force lines
10 provides the second magnetic force for the second actuating coil set.

Preferably, the second actuating coil set includes a coil holding the magnetic force line generator therein, which has a coil wall thereof substantially perpendicular to the second substantially linear portion.

According to a second aspect of the present invention, an
15 electromagnetic actuator for moving an object along a first direction and a second direction. The electromagnetic actuator includes a magnetic force line generator including two homopolar parts spaced with a clearance small enough for generating magnetic force lines including a first substantially linear portion and a second substantially linear portion
20 due to a repelling force between the two homopolar parts; a first actuating coil set connected to the object and arranged around the magnetic force line generator with a coil wall thereof substantially perpendicular to the first substantially linear portion for moving the object in the first direction in response to a first current density therein
25 and the magnetic force lines; and a second actuating coil set connected to the object and arranged around the magnetic force line generator with a coil wall thereof substantially perpendicular to the second

substantially linear portion for moving the object in the second direction in response to a second current density therein and the magnetic force lines.

According to a third aspect of the present invention, an
5 electromagnetic actuator for moving an object along a first direction and
a second direction includes a first actuating coil set connected to the
object for generating a first actuating force to move the object in the first
direction in response to a first current density therein and a first
magnetic force; a second actuating coil set connected to the object for
10 generating a second actuating force to move the object in the second
direction in response to a second current density therein and a second
magnetic force; and a magnetic force line generator including two
spaced homopolar parts which is surrounded by said first actuating coil
set, and sandwiched by said second actuating coil set for providing said
15 first and said second magnetic forces for said first and said second
actuating coil sets, respectively, by generating magnetic force lines due
to a repelling force therebetween.

BRIEF DESCRIPTION OF THE DRAWINGS

20 The present invention may best be understood through the
following description with reference to the accompanying drawings, in
which:

Fig. 1 is a schematic diagram showing the coil arrangement of a
first conventional electromagnetic actuator;

25 Fig. 2 is a schematic diagram showing the coil arrangement of a
second conventional electromagnetic actuator;

Figs. 3A and 3B are schematic diagrams showing the coil

arrangement of a third conventional electromagnetic actuator wherein Fig. 3B is a cross-sectional view taken along an A-A' line of Fig. 3A;

Figs. 4A~4C are schematic diagrams showing the coil arrangement of a preferred embodiment of an electromagnetic actuator according to the present invention wherein Fig. 3B is a cross-sectional view taken along an B-B line of Fig. 3A and Fig. 3C is a top plane view of Fig. 3A;

Fig. 5A is a perspective view schematically showing the integration of an electromagnetic actuator according to the present invention with an objective lens holder into an optical head;

Fig. 5B is a top plane view of Fig. 5A; and

Figs. 5C~5E are cross-sectional views taken along C-C', D-D' and E-E' lines of Fig. 5A, respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will now be described more specifically with reference to the following embodiments. It is to be noted that the following descriptions of preferred embodiments of this invention are presented herein for purpose of illustration and description only; it is not intended to be exhaustive or to be limited to the precise form disclosed.

Please refer to Figs. 4A~4C which schematically show a preferred embodiment of an electromagnetic actuator according to the present invention. The electromagnetic actuator includes a magnetic force line generator 21, a first actuating coil set 22 and a second actuating coil set 23. The magnetic force line generator 21 provides magnetic forces for the actuating coil sets 22 and 23. The actuating coil sets 22 and 23 are connected to an object (not shown) and move the object in response to the magnetic forces and currents applied thereinto. By controlling the

density and the direction of a current in a coil, as indicated by arrows 30 or 31 in Fig. 4B or 4C, the level and the direction of the movement is controlled. For example, if the directions of the magnetic force and the current applied to the coil set 22 are respectively indicated by those thin and thick arrows in Fig. 4B, the coil set 22 will vertically move upwards from the paper position, as indicated by the symbol with a reference numeral 32. Likewise, if the directions of the magnetic force and the current applied to the coil set 23 are respectively indicated by those thin and thick arrows in Fig. 4C, the coil set 23 will vertically move upwards from the paper position, as indicated by the symbol with a reference numeral 34.

The magnetic force line generator 21 includes two spaced permanent magnets 211 and 212 with respective homopolar parts 213 and 214 facing with each other. Between the two homopolar parts 213 and 214, there exists a small clearance d . In this embodiment, the homopolar parts are respective N poles of the two magnetic magnets. Alternatively, the two permanent magnets 211 and 212 may have respective S poles thereof facing each other as the two homopolar parts 213 and 214. Under this circumstances, changing the directions of the currents in the coils may achieve the same movement effects. Owing to the repelling force and the small clearance between the two homopolar parts, the magnetic force lines generated by the two permanent magnets are compressed so as to include a first smooth portion 215 and a second smooth portion 216 which are preferably linear. The first actuating coil set 22 includes a coil surrounding the homopolar parts 213 and 214, and passing therethrough the first linear portion of magnetic force lines 215. The second actuating coil set 23 includes two coils 231 and 232

disposed at two opposite sides of the homopolar parts 213 and 214 to sandwich the homopolar parts 213 and 214 therebetween, and passing therethrough the second linear portion of magnetic force lines 216. By arranging the actuating coils 22 and 23 at properly positions and orientations, the coil walls 223 and 233 are desirably made to be perpendicular to the linear portions 215 and 216 of the magnetic force lines, respectively, so that the utilization rate of the magnetic circuit of the electromagnetic actuator is maximized. For example, the utilization rate for the first coil set 22 is almost 100%, and that for the second coil set 23 can be up to 80%, and 70%~80% in general. The result is apparent to be superior to the conventional ones.

Please refer to Figs. 5A~5E which schematically show the integration of an electromagnetic actuator according to the present invention with an objective lens holder into an optical head. As shown in the drawings, the optical head 50 includes a lens holder 51 for holding an objective lens 52 therein, four suspending copper wires 53 for supporting the lens holder 51 in a suspending state, a circuit board 54 welded thereon the copper wires 53 and screwed to a lower yoke 56, and an electromagnetic actuator 55 connected to the lens holder 51 for moving the objective lens 52 on micro levels along a focusing direction F and/or a tracking direction T. Using the embodiment of Fig. 4 as the electromagnetic actuator 55 herein, the two spaced permanent magnets 211 and 212 are secured to an upper yoke (not shown) and the lower yoke 56, respectively, and the positions of the coils 22, 231 and 232 are also illustrated with reference to Figs. 5A, 5C and 5D. Further, a damping device 57 filled with a damping agent is used to provide a proper damping coefficient for the lens holder 51 upon vibration.

While the invention has been described in terms of what are presently considered to be the most practical and preferred embodiments, it is to be understood that the invention need not be limited to the disclosed embodiment. On the contrary, it is intended to
5 cover various modifications and similar arrangements included within the spirit and scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structures.

WHAT IS CLAIMED IS:

1. An electromagnetic actuator for moving an object along a first direction and a second direction, comprising:

5 a magnetic force line generator including two homopolar parts spaced with a clearance small enough for generating magnetic force lines including a first substantially linear portion and a second substantially linear portion due to a repelling force between said two homopolar parts;

10 a first actuating coil set connected to said object and arranged around said magnetic force line generator with a coil wall thereof substantially perpendicular to said first substantially linear portion for moving said object in said first direction in response to a first current density therein and said magnetic force lines; and

15 a second actuating coil set connected to said object and arranged around said magnetic force line generator with a coil wall thereof substantially perpendicular to said second substantially linear portion for moving said object in said second direction in response to a second current density and said magnetic force lines.

- 20 2. The electromagnetic actuator according to claim 1 wherein said first direction is a focusing direction, and said first actuating coil set includes a coil surrounding said magnetic force line generator.
3. The electromagnetic actuator according to claim 2 wherein said second direction is a tracking direction, and said second actuating coil set includes two coils positioned at two opposite sides of said magnetic force line generator.
- 25 4. The electromagnetic actuator according to claim 1 wherein said magnetic force line generator includes two permanent magnets

having respective N poles facing each other as said two homopolar parts.

5 5. The electromagnetic actuator according to claim 1 wherein said magnetic force line generator includes two permanent magnets having respective S poles facing each other as said two homopolar parts.

6. The electromagnetic actuator according to claim 1 for moving said object along said first and said second directions on micro levels.

10 7. The electromagnetic actuator according to claim 6 wherein said object is an objective lens holder of an optical head of an information writing/reading apparatus.

8. An electromagnetic actuator for moving an object along a first direction and a second direction, comprising:

15 a first actuating coil set connected to said object for generating a first actuating force to move said object in said first direction in response to a first current therein and a first magnetic force;

a second actuating coil set connected to said object for generating a second actuating force to move said object in said second direction in response to a second current therein and a second magnetic force; and
20 force; and

a magnetic force line generator including two spaced homopolar parts which is surrounded by said first actuating coil set, and sandwiched by said second actuating coil set for providing said first and said second magnetic forces for said first and said second actuating coil sets, respectively, by generating magnetic force lines due to a repelling force therebetween.
25

9. The electromagnetic actuator according to claim 8 wherein said first

direction is a focusing direction, and said second direction is a tracking direction.

10. The electromagnetic actuator according to claim 9 wherein said first
actuating coil set includes a coil holding said magnetic force line
generator therein and said second actuating coil set consists of two
coils disposed at two opposite sides of said magnetic force line
generator, respectively.
11. The electromagnetic actuator according to claim 8 wherein said
magnetic force lines includes a first substantially linear portion
substantially perpendicular to a coil wall of said first actuating coil
set, and a second substantially linear portion substantially
perpendicular to a coil wall of said second actuating coil set.
12. The electromagnetic actuator according to claim 8 wherein said
object is an objective lens holder of an optical head of an
information writing/reading apparatus.
13. The electromagnetic actuator according to claim 12 for moving said
object along said first and said second directions on micro levels.
14. The electromagnetic actuator according to claim 13 wherein said
magnetic force line generator includes two permanent magnets
having respective homopoles facing each other as said two
homopolar parts.
15. An electromagnetic actuator for moving an object along a first
direction, comprising:
a first actuating coil set connected to said object for generating
a first actuating force to move said object in said first direction in
response to a first current therein and a first magnetic force; and
a magnetic force line generator surrounded by said first

actuating coil set, and including two homopolar parts disposed with a clearance small enough for generating magnetic force lines including a first substantially linear portion due to a repelling force between said two homopolar parts, wherein said first substantially linear portion of magnetic force lines provides said first magnetic force for said first actuating coil set.

16. The electromagnetic actuator according to claim 15 wherein said first direction is a focusing direction, and said first actuating coil set includes a coil holding said magnetic force line generator therein.

17. The electromagnetic actuator according to claim 16 for further moving said object along a tracking direction perpendicular to said focusing direction.

18. The electromagnetic actuator according to claim 17 further comprising a second actuating coil set connected to said object for generating a second actuating force to move said object in said tracking direction in response to a second current therein and a second magnetic force.

19. The electromagnetic actuator according to claim 18 wherein said magnetic force lines further includes a second substantially linear portion due to said repelling force between said two homopolar parts, wherein said second substantially linear portion of magnetic force lines provides said second magnetic force for said second actuating coil set.

20. The electromagnetic actuator according to claim 19 wherein said second actuating coil set consists of two coils disposed at two opposite sides of said magnetic force line generator, respectively, each of which has a coil wall thereof substantially perpendicular to

said second substantially linear portion.

21. The electromagnetic actuator according to claim 15 wherein said magnetic force line generator includes two permanent magnets having respective homopoles facing each other as said two homopolar parts.
22. The electromagnetic actuator according to claim 15 wherein said first direction is a tracking direction, and said first actuating coil set includes two coils sandwiching said magnetic force line generator therebetween.
23. The electromagnetic actuator according to claim 22 for further moving said object along a focusing direction perpendicular to said tracking direction.
24. The electromagnetic actuator according to claim 23 further comprising a second actuating coil set connected to said object for generating a second actuating force to move said object in said focusing direction in response to a second current density therein and a second magnetic force.
25. The electromagnetic actuator according to claim 24 wherein said magnetic force lines further includes a second substantially linear portion due to said repelling force between said two homopolar parts, wherein said second substantially linear portion of magnetic force lines provides said second magnetic force for said second actuating coil set.
26. The electromagnetic actuator according to claim 25 wherein said second actuating coil set includes a coil holding said magnetic force line generator therein, which has a coil wall thereof substantially perpendicular to said second substantially linear portion.

ELECTROMAGNETIC ACTUATOR HAVING SPECIFIC COIL
ARRANGEMENT FOR IMPROVING UTILIZATION RATE
OF MAGNETIC CIRCUIT THEREOF

5 ABSTRACT OF THE DISCLOSURE

An electromagnetic actuator with an improved utilization rate of magnetic circuit for efficiently moving an objective lens on micro levels along a focusing direction and a tracking direction is disclosed. The electromagnetic actuator includes two homopolar parts spaced with a clearance small enough for generating magnetic force lines including a first and a second smooth portions which are preferably linear. The electromagnetic actuator further includes a first and a second actuating coil sets connected to the holder of the objective lens for moving the objective lens along the focusing and the tracking directions, respectively. The first and the second actuating coil sets are arranged around the homopolar parts with coil walls thereof substantially perpendicular to the first and the second smooth portions, respectively, so that they themselves move in the focusing and/or tracking directions in response to the currents and the magnetic force lines applied thereto to actuate the lens holder.

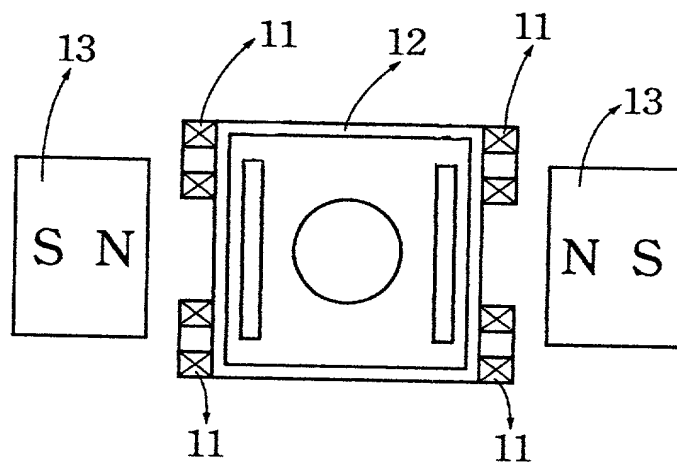


Fig.1(a)

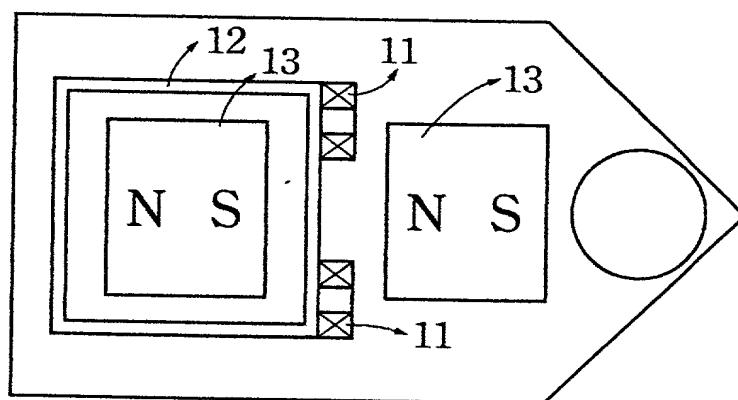


Fig.1(b)

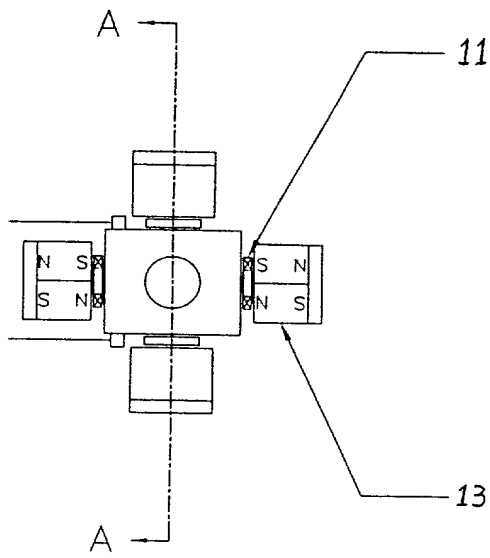
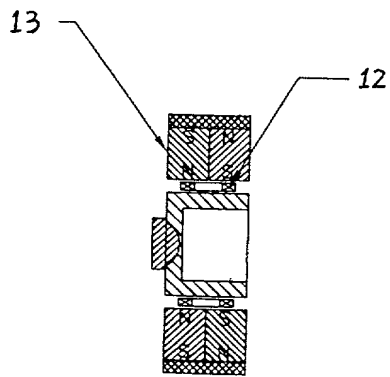


Fig.1(c1)



A-A SECTION

Fig.1(c2)

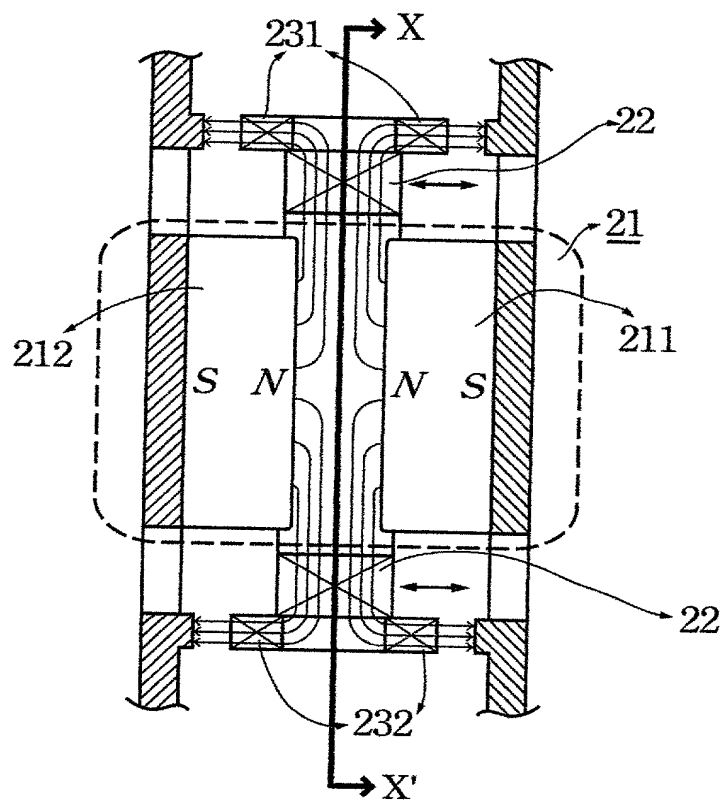


Fig.2(a)

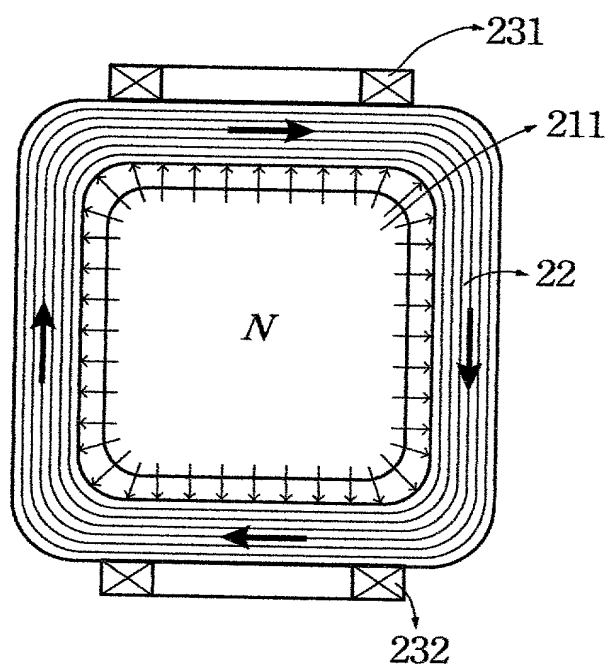


Fig.2(b)

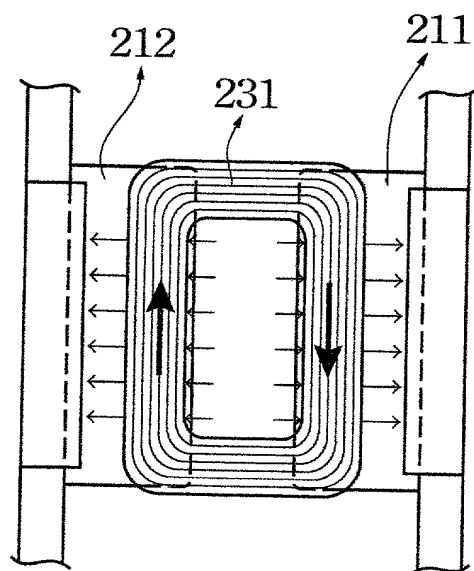


Fig.2(c)

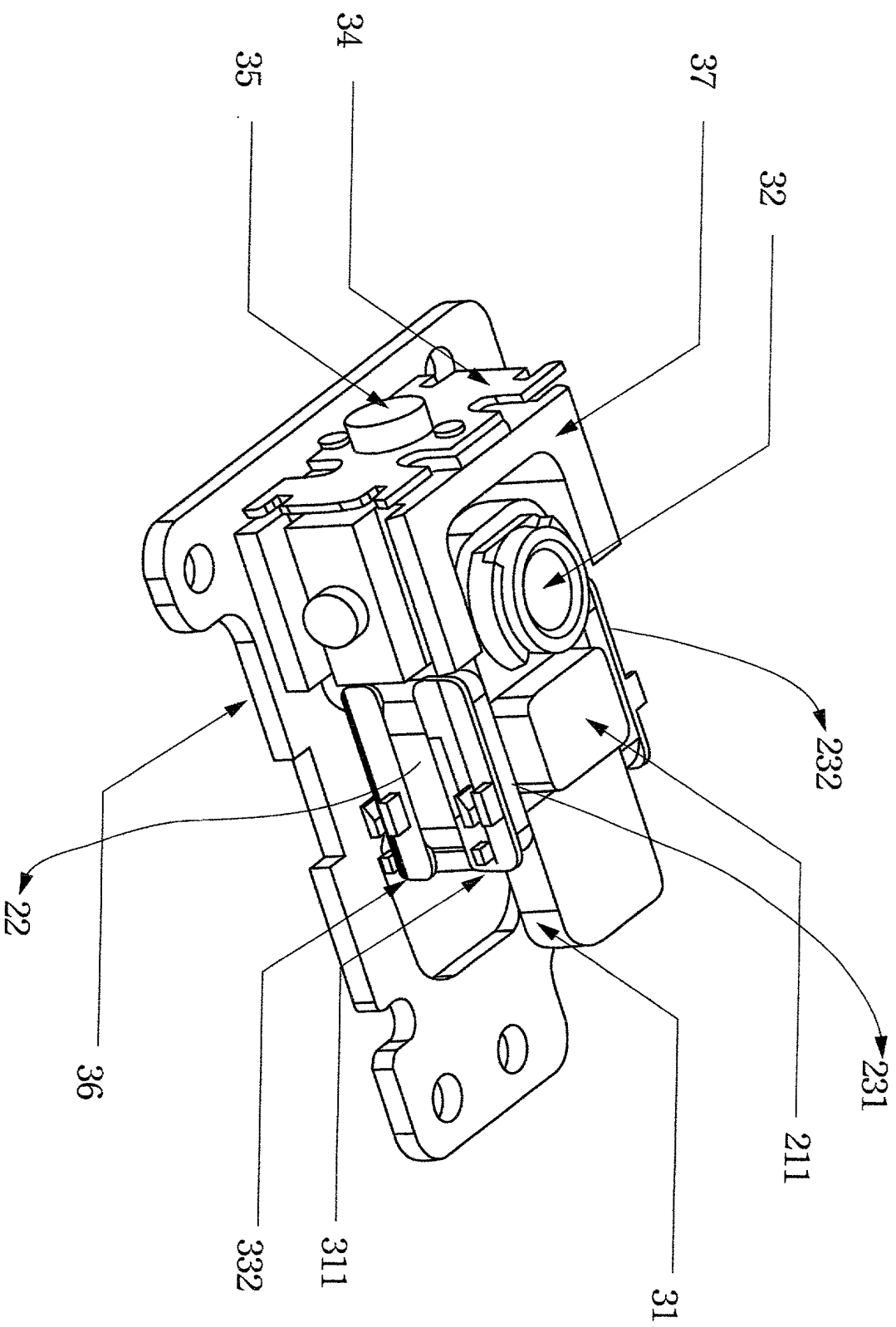


Fig.3(a)

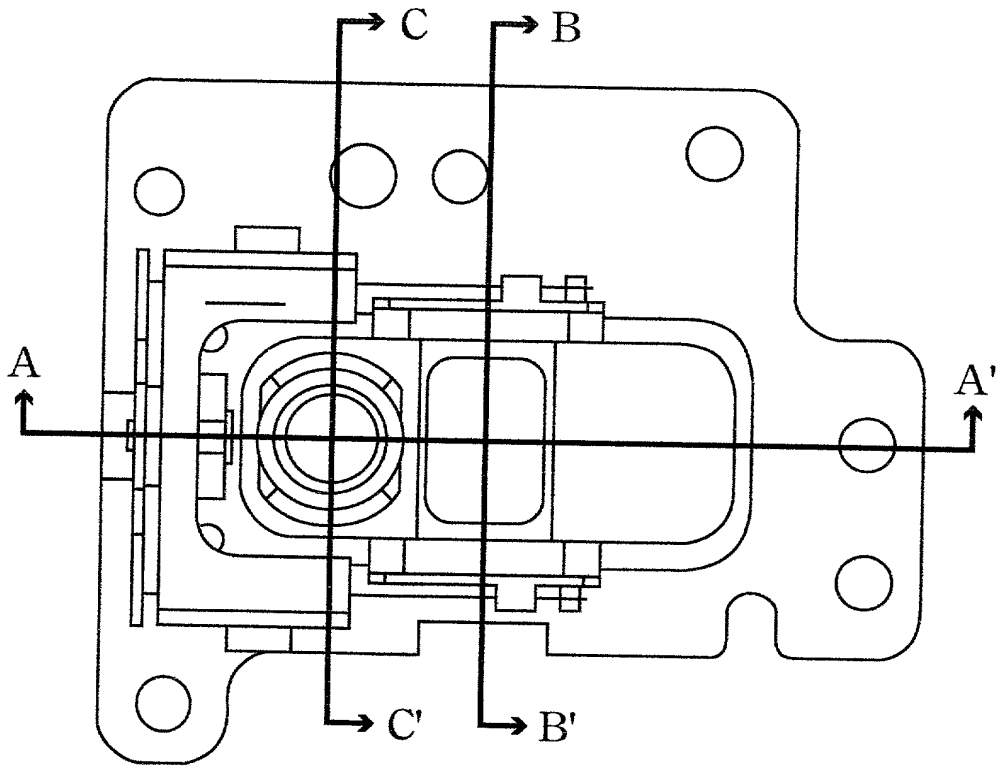


Fig.3(b)

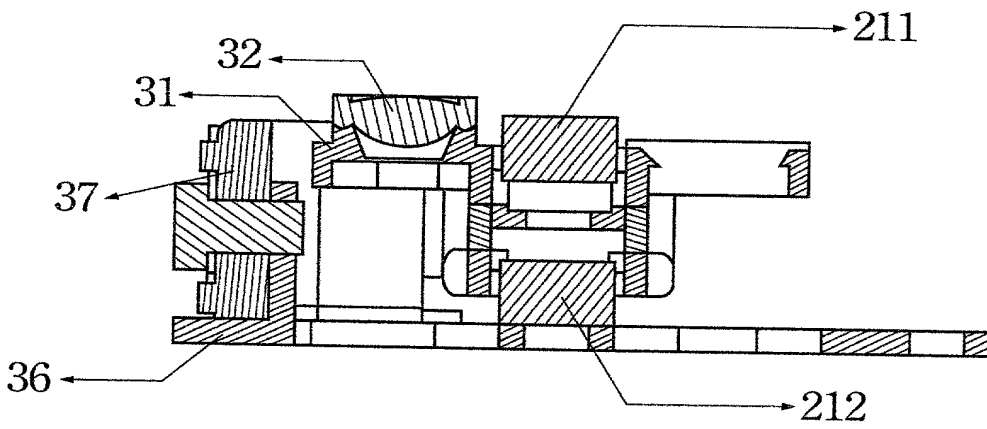


Fig.3(c)

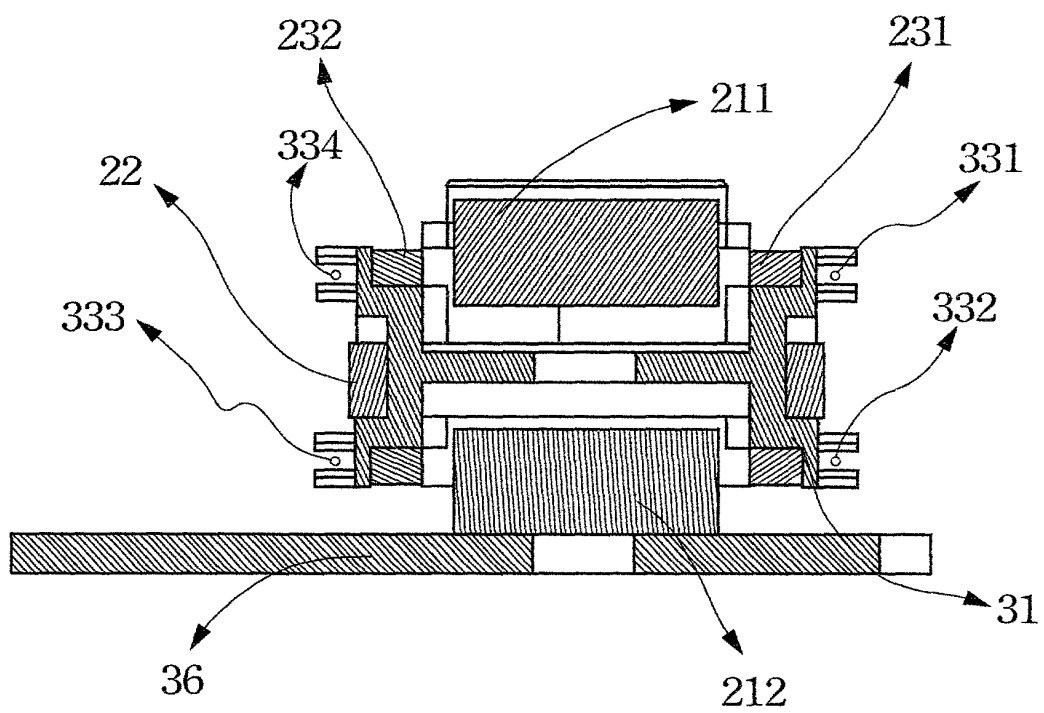


Fig.3(d)

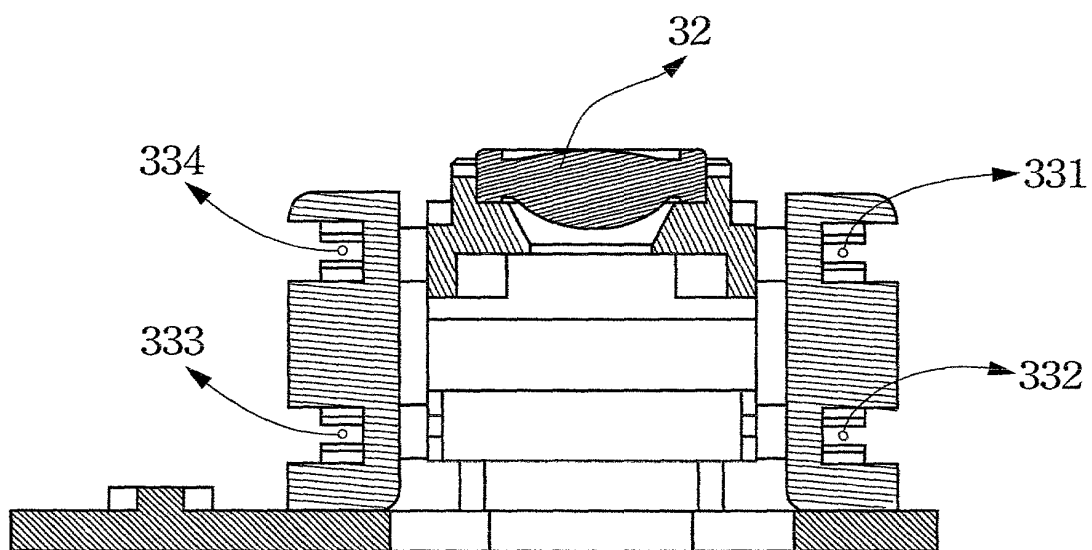


Fig.3(e)

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter claimed and for which a patent is sought on the invention entitled ELECTROMAGNETIC ACTUATOR HAVING SPECIAL COIL ARRANGEMENT FOR IMPROVING UTILIZATION RATE OF MAGNETIC CIRCUIT THEREOF, the specification of which

[] is attached hereto [] was filed on as Application Serial No. and was amended on (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known to me to be material to patentability in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):

Priority Claimed

Number Country Day/Month/Year filed

Yes No

I hereby claim the benefit under 35 USC §119(e) of any United States provisional application(s) listed below.

Prior Provisional Application(s):

Application Number Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U. S. Application(s):

Serial No.

Filing Date

Status: Patented, Pending, Abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorney(s) and/or agent(s): Allan M. Lowe, Reg. No. 19,641; Israel Gopstein, Reg. No. 27,333; Benjamin J. Hauptman, Reg. No. 29,310; Kenneth M. Berner, Reg. No. 37,093; Michael G. Gilman, Reg. No. 19,114; and Randy Noranbrock, Reg. No. 42,940, all of

LOWE HAUPTMAN GOPSTEIN GILMAN & BERNER, LLP
1700 Diagonal Road, Suite 310
Alexandria, Virginia 22314

with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and all future correspondence should be addressed to them.

Full name of sole or first inventor: CHIN-SUNG LIU

Inventor's signature: CHIN-SUNG LIU

Date: 26, Oct, 2000

Residence: NO. 19, SECTION 8, CHIA-CHAN STREET, MIOU-LI COUNTY, TAIWAN, R.O.C.

Citizenship: TAIWAN, R.O.C.

Post Office Address: NO.25, SECTION 2, R&D ROAD, SCIENCE-BASED INDUSTRIAL PARK,
HSIN-CHU, TAIWAN, R.O.C.

Full name of second joint inventor: LI-CHUNG PENG

Inventor's signature: Li-chung Peng

Date: 26 Oct. 2000

Residence: 8F, NO. 18, LANE 7, SEGMENT 298, SECTION 2, KUAN-FU ROAD, SHIN-CHU,
TAIWAN, R.O.C.

Citizenship: TAIWAN, R.O.C.

Post Office Address: NO.25, SECTION 2, R&D ROAD, SCIENCE-BASED INDUSTRIAL PARK,
HSIN-CHU, TAIWAN, R.O.C.

Full name of third joint inventor: AN-YING HUANG

Inventor's signature: An-ying Huang

Date: 26 Oct. 2000

Residence: NO. 108-1, LIAU-BU VILLAGE, MA-DO TOWN, TAINAN COUNTY, TAIWAN, R.O.C.

Citizenship: TAIWAN, R.O.C.

Post Office Address: NO.25, SECTION 2, R&D ROAD, SCIENCE-BASED INDUSTRIAL PARK,
HSIN-CHU, TAIWAN, R.O.C.

Full name of fourth joint inventor:

Inventor's signature:

Date:

Residence:

Citizenship:

Post Office Address:
